Appl. No.: 10/021,318
Amdt. Dated: 06/16/2005
Off. Act. Dated: 04/05/2005

Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

Claims 1-53 (canceled)

54. (currently amended): ~~A method as recited in claim 53, further comprising~~: A method of improving congestion control of data packets transmitted over a communication network employing transmission control protocol (TCP), said data packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining direction of said congestion by estimating relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

determining whether congestion is developing in a forward path;

isolating forward throughput from congestion occurring on a reverse path; and

in the absence of congestion in the reverse path, avoiding retransmission of data packets as a result of a timeout when there are a plurality of packet losses in a time window.

55. (currently amended): A method as recited in claim [[52]] 54 or 59:

wherein said relative delay comprises increases and decreases in delay that said data packets experience with respect to each other; and

further comprising calculating said relative delay from a timestamp returned by a receiver of a data packet in an acknowledgment packet;

said timestamp specifying arrival time of a data packet at the receiver.

56. (previously presented): A method as recited in claim 55, further comprising determining the presence of multiple paths to a destination by timestamps returned from receivers of said data packets.

57. (currently amended): A method as recited in claim [[52]] 54 or 59, further comprising determining whether congestion is increasing or decreasing in either a forward or reverse path.

58. (currently amended): A method as recited in claim [[52]] 54 or 59, wherein determination of congestion direction allows that portion of the forward path to be isolated from events, or congestion, that may occur on the reverse path.

59. (currently amended): ~~A method as recited in claim 52,~~ A method of improving congestion control of data packets transmitted over a communication network employing transmission control protocol (TCP), said packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining direction of said congestion by estimating relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

wherein said source has a congestion window;~~, and further comprising:~~

estimating the number of packets which reside in a bottleneck queue from said relative delay; and

keeping the number of packets in said bottleneck queue at a desired minimum by adjusting the congestion window of the source.

60. (currently amended): A method as recited in claim [[52]] 54 or 59, wherein said TCP has an options field, and further comprising using said options field to detect

the initial stage of congestion and determine the direction of congestion.

61. (canceled)

62. (currently amended): ~~A method as recited in claim 61, further comprising:~~ A method of improving congestion control of data packets transmitted over a communication network employing transmission control protocol (TCP), said packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining direction of said congestion by estimating relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

determining whether congestion is developing in a forward path;

isolating forward throughput from congestion occurring on a reverse path; and

in the absence of congestion in the reverse path, avoiding retransmission of data packets as a result of a timeout when there are a plurality of packet losses in a time window.

63. (currently amended): A method as recited in claim [[61]] 62 or 66:

wherein said relative delay comprises increases and decreases in delay that said data packets experience with respect to each other; and

further comprising calculating said relative delay from a timestamp returned by a receiver of a data packet in an acknowledgment packet;

said timestamp specifying arrival time of a data packet at the receiver.

64. (previously presented): A method as recited in claim 63, further comprising determining the presence of multiple paths to a destination by timestamps returned from receivers of said data packets.

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65. (currently amended): A method as recited in claim [[61]] 62 or 66, further comprising determining whether congestion is increasing or decreasing in either a forward or reverse path.

66. (currently amended): ~~A method as recited in claim 61,~~ A method of improving congestion control of data packets transmitted over a communication network employing transmission control protocol (TCP), said packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining direction of said congestion by estimating relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

determining whether congestion is developing in a forward path;

isolating forward throughput from congestion occurring on a reverse path;

wherein said source has a congestion window, ~~and further comprising:~~

estimating the number of packets which reside in a bottleneck queue from said relative delay; and

keeping the number of packets in said bottleneck queue at a desired minimum by adjusting the congestion window of the source.

67. (currently amended): A method as recited in claim [[61]] 62 or 66, wherein said TCP has an options field, and further comprising using said options field to detect the initial stage of congestion and determine the direction of congestion.

Claims 68-69 (canceled)

70. ~~A method as recited in claim 69, further comprising:~~ A method of improving congestion control of data packets transmitted over a communication network

employing transmission control protocol (TCP), said packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining the direction of said congestion by estimating the relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

said relative delay comprising increases and decreases in delay that said data packets experience with respect to each other; and

calculating said relative delay from a timestamp returned by a receiver of a data packet in an acknowledgment packet;

said timestamp specifying arrival time of a data packet at the receiver;

determining whether congestion is developing in a forward path;

isolating forward throughput from congestion occurring on a reverse path; and

in the absence of congestion in the reverse path, avoiding retransmission of data packets as a result of a timeout when there are a plurality of packet losses in a time window.

71. (currently amended): A method as recited in claim [[68]] 70 or 74, further comprising determining the presence of multiple paths to a destination by timestamps returned from receivers of said data packets.

72. (currently amended): A method as recited in claim [[68]] 70 or 74, further comprising determining whether congestion is increasing or decreasing in either a forward or reverse path.

73. (currently amended): A method as recited in claim [[68]] 70 or 74, wherein determination of congestion direction allows that portion of the forward path to be isolated from events, or congestion, that may occur on the reverse path.

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74. (currently amended): ~~A method as recited in claim 68,~~ A method of improving congestion control of data packets transmitted over a communication network employing transmission control protocol (TCP), said packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining direction of said congestion by estimating relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

said relative delay comprising increases and decreases in delay that said data packets experience with respect to each other;

calculating said relative delay from a timestamp returned by a receiver of a data packet in an acknowledgment packet;

said timestamp specifying arrival time of a data packet at the receiver;

wherein said source has a congestion window, ~~and further comprising:~~

estimating the number of packets which reside in a bottleneck queue from said relative delay; and

keeping the number of packets in said bottleneck queue at a desired minimum by adjusting the congestion window of the source.

75. (previously presented): A method of improving congestion control of data packets transmitted over a communication network employing transmission control protocol (TCP), said packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining the direction of said congestion by estimating the relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

determining whether congestion is developing in a forward path;

isolating forward throughput from congestion that may occur on a reverse path; and

in the absence of congestion in the reverse path, avoiding retransmission of data packets as a result of a timeout when there are a plurality of packet losses in a time window.

76. (previously presented): A method as recited in claim 75:

wherein said relative delay comprises increases and decreases in delay that said data packets experience with respect to each other; and

further comprising calculating said relative delay from a timestamp returned by a receiver of a data packet in an acknowledgment packet;

said timestamp specifying arrival time of a data packet at the receiver.

77. (previously presented): A method as recited in claim 76, further comprising determining the presence of multiple paths to a destination by timestamps returned from receivers of said data packets.

78. (previously presented): A method as recited in claim 75, further comprising determining whether congestion is increasing or decreasing in either a forward or reverse path.

79. (previously presented): A method as recited in claim 75, wherein determination of congestion direction allows that portion of the forward path to be isolated from events, or congestion, that may occur on the reverse path.

80. (previously presented): A method as recited in claim 75, wherein said source has a congestion window, and further comprising:

estimating the number of packets which reside in a bottleneck queue from said

relative delay; and

keeping the number of packets in said bottleneck queue at a desired minimum by adjusting the congestion window of the source.

81. (previously presented): A method as recited in claim 75, wherein said TCP has an options field, and further comprising using said options field to detect the initial stage of congestion and determine the direction of congestion.

82. (previously presented): A method of improving congestion control of data packets transmitted over a communication network employing transmission control protocol (TCP), said packets transmitted from a source to a destination, said method comprising:

detecting an initial stage of congestion;

determining the direction of said congestion by estimating the relative delay that one data packet experiences with respect to another data packet as said data packets are transmitted over said network;

determining whether congestion is developing in a forward path;

isolating forward throughput from congestion that may occur on a reverse path;

in the absence of congestion in the reverse path, avoiding retransmission of data packets as a result of a timeout when there are a plurality of packet losses in a time window;

wherein said relative delay comprises increases and decreases in delay that said data packets experience with respect to each other; and

calculating said relative delay from a timestamp returned by a receiver of a data packet in an acknowledgment packet;

said timestamp specifying arrival time of a data packet at the receiver.

83. (previously presented): A method as recited in claim 82, further comprising determining the presence of multiple paths to a destination by timestamps returned from receivers of said data packets.

84. (previously presented): A method as recited in claim 82, further comprising determining whether congestion is increasing or decreasing in either a forward or reverse path.

85. (previously presented): A method as recited in claim 82, wherein said source has a congestion window, and further comprising:

estimating the number of packets which reside in a bottleneck queue from said relative delay; and

keeping the number of packets in said bottleneck queue at a desired minimum by adjusting the congestion window of the source.

86. (previously presented): A method as recited in claim 82, wherein said TCP has an options field, and further comprising using said options field to detect the initial stage of congestion and determine the direction of congestion.